IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of:	Thomas N. Chalin, et al.
Serial No.:	10/600,051
Filed:	June 20, 2003
Entitled:	SUSPENSION SYSTEM HAVING A COMPOSITE BEAM
Group Art Unit:	3616
Examiner:	F. Fleming

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Appellants hereby timely submit this Appeal Brief under the provisions of 37 CFR §41.37 and respectfully request consideration thereof before the Board of Patent Appeals and Interferences. Appellants' Notice of Appeal was filed on November 18, 2008, appealing to the Board from the decision of the examiner, mailed August 18, 2008, finally rejecting the claims of the above-identified patent application. This is a second Appeal Brief in the application.

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REAL PARTY IN INTEREST

The real party in interest is the assignee of the present application, Watson & Chalin Manufacturing, Inc. of McKinney, Texas.

RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences known to appellants, the appellants' legal representatives or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

STATUS OF CLAIMS

Claims 1-53 were originally filed in the present application.

Claims 8, 10, 11 and 47 are canceled.

Claims 3, 5, 12-28, 31-36, 42, 43, 45, 48, 50 and 51 are presently withdrawn from consideration pursuant to a requirement for election of species.

Claims 1, 2, 4, 6, 7, 9, 29, 30, 37-41, 44, 46, 49, 52 and 53 are currently pending and being considered in the application.

Claims 1, 2, 4, 6-9, 29, 30, 37-41, 44, 46, 49, 52 and 53 are rejected in the Office Action, although claim 8 is canceled.

Claims 1, 2, 4, 6, 7, 9, 29, 30, 37-41, 44, 46, 49, 52 and 53 are being appealed.

STATUS OF AMENDMENTS

No amendments have been filed after the date of the August 19, 2009 Office Action.

SUMMARY OF CLAIMED SUBJECT MATTER

In one important aspect of the invention recited in independent claim 1 (an embodiment of which is depicted in FIG. 11 of the drawings), a vehicle suspension system includes an axle 132 and a beam 152 interconnected between the axle and a frame of a vehicle. The embodiment depicted in FIG. 11 (a variation of the embodiment depicted in FIG. 10) is described at page 15, line 7 to page 16, line 6 of the specification.

Therein is described a suspension system 10 for a vehicle having a frame 16 (see FIG. 1, page 6, lines 3-6 and page 14, lines 2-4), the suspension system 10 comprising: an axle 132 (page 14, lines 5-6); and a beam 134 interconnected between the vehicle frame 16 and the axle 132 (page 14, lines 7-8, and page 15, line 20 to page 16, line 3), the beam 134 having opposite ends (page 14, lines 7-8, FIGS. 10 & 11), an elongated body 152 extending between the opposite ends (page 15, lines 8-12), and a metal end connection 136, 38 at one of the opposite ends (page 16, lines 1-6), the body 152 being made of a composite material (see page 15, lines 15-19), and the body 152 having a generally I-shaped cross-section (see FIG. 11 and page 15, lines 8-12).

The beam has opposite ends 136, 138, an elongated body 152 extending between the opposite ends, and a metal end connection 38 at one of the opposite ends 136. The body 152 is made of a composite material and has a generally I-shaped cross-section. Beams having generally I-shaped cross-sections are depicted in FIGS. 2, 3A, 6, 7 and 11.

In another important aspect of the invention recited in independent claim 29 and depicted in FIGS. 2 & 3A, the body 32 is made of a composite material and has a cross-section with at least two flanges 50, 52 and a vertical web 54 extending between the flanges. The embodiment depicted in FIGS. 2 & 3A is described at page 5, line 16 to page 9, line 2 of the specification.

Therein is described a suspension system 10 for a vehicle having a frame 16 (see FIG. 1 and page 6, lines 3-6), the suspension system 10 comprising: an axle 24 (page 5, lines 11 and 12); and a beam 30 interconnected between the vehicle frame 16 and the axle 24 (page 6, lines 3-12), the beam 30 having opposite ends (see FIG. 2), an elongated body 32 extending between the opposite ends (page 6, lines 7-8), an axle end connection

36 at one of the opposite ends (page 7, lines 8-11), and a frame end connection 34 at the other of the opposite ends (page 6, lines 20-21), the body 32 being made of a composite material (page 6, lines 8-19) and having a cross-section with at least two flanges 50, 52 (see FIG. 3A and page 8, lines 10-13) and a generally vertical web 54 extending between the flanges 50, 52 (page 8, lines 10-13).

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1, 2, 4, 6-9, 29, 30, 37-41, 44, 46, 49, 52 and 53 are rejected under 35 USC §103(a) as being obvious over U.S. Patent No. 6,843,490 (Raidel) in view of U.S. Patent No. 6,893,733 (Obeshaw).

ARGUMENT

The present invention advances the art of constructing vehicle suspension systems by providing a light weight beam and axle assembly in a suspension system. As part of the advancements in the art, the applicants have described how to make and use several different configurations of light weight beam and axle assemblies (see FIGS. 2-11). As will be appreciated from even a cursory review of the drawings and accompanying description, the applicants have uniquely solved the problems associated with use of composite materials in suspension systems.

One of those problems is how to connect a composite beam to an axle. If the axle is also made of a composite material, then perhaps the composite beam could be just glued to the axle, or perhaps fasteners could be utilized. If the axle is made of metal, then the available options are different, but some may be the same (such as use of fasteners).

The present applicants have solved this problem, in several embodiments, by constructing the beam so that it has upper and lower flanges 96, 98 which wrap exteriorly about a metal axle connector 44 (see FIGS. 6 & 7). The metal connector 44 can then be welded to the axle 24. If the axle is made of a composite material, the flanges can wrap exteriorly about the axle (as depicted in FIG. 11), and an opposite end

of the beam can be provided with a frame end connection 136 which wraps about a frame coupling structure 38 for receiving a pivot bushing 20 therein (see FIG. 1).

Thus, it will be appreciated that the present specification does much more than simply describe that a suspension system beam can be made of a composite material. Instead, the specification describes several embodiments which uniquely solve various problems associated with use of composite materials in suspension system components.

The rejections made in the Office Action merely cite the Raidel reference for its teaching of a typical trailing arm suspension system, cite the Obeshaw reference for its teaching of a composite material, and then summarily conclude that it would be obvious to make axles and beam bodies of a composite material. However, the claims recite much more than this. The claims recite a particular configuration of a beam in a particular type of suspension system, and the invention is clearly not rendered obvious in view of the teachings of the Raidel and Obeshaw references.

Rejections under 35 USC §103(a) over Raidel in view of Obeshaw

The first step in the *Graham v. John Deere* factual inquiries, which are used as a background for determining obviousness, is to determine the scope and content of the prior art. In the present case, all of the claims being considered have been rejected as obvious over a proposed combination of the teachings of the Raidel and Obeshaw references. An analysis of these references follows.

Raidel describes a typical trailing arm suspension system of the type illustrated in FIG. 1 of the present application. Compare FIG. 1 of Raidel to FIG. 1 of the present application. They are very similar.

The present applicants do not claim to have invented the trailing arm suspension system. Such suspension systems have been known for perhaps a century. Instead, the present applicants have described and claimed unique ways of constructing a suspension system with a composite beam, so that the problems associated with using a composite beam in a suspension system are solved.

At this point, it is instructive to note that Raidel does not describe a suspension beam having an I-shaped cross-section. FIGS. 2, 4 & 5 of Raidel are reproduced below for the Board's convenience:

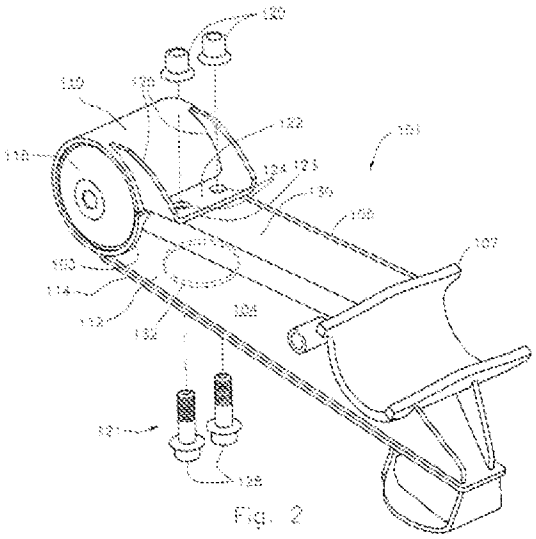

Fig. 2

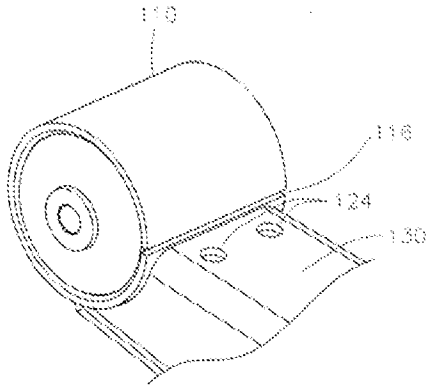

Fig. 4

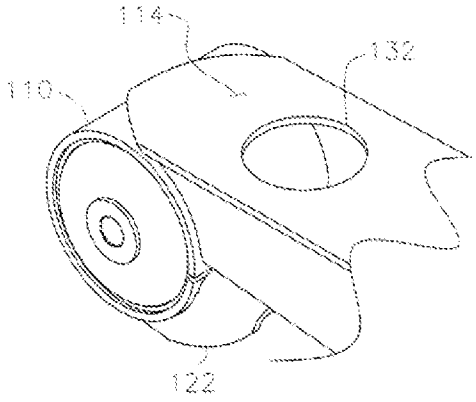

Fig. 5

As can be clearly seen in these figures, the Raidel suspension arm is made up of a U-shaped beam member 130 with a top plate 114, thereby forming a rectangular box-shaped cross-section (not an I-shaped cross-section). The top plate 114 can also be left off, thereby forming a U-shaped cross-section (also not an I-shaped cross-section). This is exactly how Raidel describes the suspension arm (see col. 3, lines 19-25).

Obeshaw describes a crushable structural member made of a composite material. A crushable structural member may be useful, for example, in a steering column (see FIG. 21 and col. 8 lines 38-49), so that the steering column collapses, instead of piercing a driver's body, when a vehicle has a front-end collision. For this purpose, the structural

member includes an initiator which causes the member to crush at the location of the initiator (col. 2, lines 14-17).

Claims 1, 2, 4 and 6

Independent claim 1 recites that a beam body made of a composite material has a metal end connection at one of its opposite ends, with the body having a generally I-shaped cross-section. For example, in the embodiment of FIG. 11 discussed above, a sleeve 38 for a pivot bushing 20 is secured at one end of a composite I-shaped beam body 152.

In contrast, Raidel describes a U- or box-shaped suspension arm. Raidel also does not describe how a metal end connection could be incorporated into a composite beam body.

These deficiencies in the Raidel reference are not cured at all by combining it with the Obeshaw reference. Obeshaw merely describes a crushable composite structure (unsuitable, it appears, for constructing a suspension arm).

As stated in MPEP §2142, for a *prima facie* case of obviousness to be established, "... the reference (or references when combined) must teach or suggest all the claim limitations." In the present case, all the claim limitations have clearly not been taught or suggested by the combination of the Raidel and Obeshaw references. For at least this reason, the Board is respectfully requested to direct the examiner to withdraw the claim rejections.

Even if a *prima facie* case of obviousness had been made out, the rejections do not satisfy the requirements set forth in the seminal U.S. Supreme Court case of *Graham v. John Deere* for evaluating whether an invention would have been obvious to a person of ordinary skill in the art at the time the invention was made. These requirements include determining the level of skill of the person having ordinary skill in the art, the scope and content of the prior art, and the differences between the claimed invention and the prior art. Additional considerations may include factors such as failure of others to solve the relevant problem, long felt but unsatisfied need, skepticism

of others, teaching away in the prior art, unexpected results, copying, the pace of innovation in the art, commercial success, industry accolades, etc.

In the *Graham v. John Deere* opinion, the Supreme Court also explicitly warned against "slipping into use of hindsight" in obviousness determinations. *Graham v. John Deere Co.*, 383 U.S. 1, 36 (1966). Additionally, in the more recent case of *KSR v. Teleflex*, the Supreme Court has reiterated that an invention's merit is not to be evaluated from a perspective of a person having the benefit of already knowing the solution conceived by the inventor, but rather as it would have been perceived by a person having only ordinary skill in the pertinent art. *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1742-43 (2007).

In the present case, the person having ordinary skill in the art would likely have a bachelor's degree in engineering or a related applied science field, and would likely have several years' experience in designing suspension system components. Such a person would be aware of conventional trailing arm suspension systems.

The scope and content of the prior art have been discussed above. However, it should be reiterated here that Raidel does not describe how the problems of making a suspension system arm out of composite materials could be solved, and Obeshaw does not describe any composite structure which is configured for use as a suspension system arm.

The differences between the prior art and the claimed invention are that none of the references describes a suspension system arm or beam made of a composite material, with a metal end connection at one of its opposite ends, and with a body of the beam having a generally I-shaped cross-section. Some of these features are described in the cited references, but in no way describing or suggesting how the problems of making a composite suspension system arm could be solved.

The Board of Patent Appeals and Interferences recently addressed this issue in *Ex Parte Whalen II* (Appeal 2007-4423, July 23, 2008) as follows:

> The U.S. Supreme Court recently held that rigid and mandatory application of the "teaching-suggestion-motivation," or TSM, test is incompatible with its precedents. *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1741 (2007). The Court did not, however, discard the TSM test completely; it noted that its

> precedents show that an invention "composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *Id.*
>
> The Court held that the TSM test must be applied flexibly, and take into account a number of factors "in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed." *Id.* at 1740-41. Despite this flexibility, however, the Court stated that "it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the [prior art] elements in the way the claimed new invention does." *Id.* "To facilitate review, this analysis should be made explicit." *Id.*
>
> [W]hen the prior art teaches away from the claimed solution as presented here . . . obviousness cannot be proven merely by showing that a known composition could have been modified by routine experimentation or solely on the expectation of success; it must be shown that those of ordinary skill in the art would have had some apparent reason to modify the known composition in a way that would result in the claimed composition.

In the present case, no convincing reasoning has been presented as to why a person skilled in the art would have been motivated to make the invention recited in the claims. The Raidel reference merely describes a conventional trailing arm suspension system. The Obeshaw reference merely describes a crushable composite structure. There is no reason why a person skilled in the art would use the Obeshaw crushable composite structure in the Raidel suspension system.

For this additional reason, the Board is respectfully requested to direct withdrawal of the rejections of claim 1 and its dependents.

Claim 7

This claim is dependent from claim 1 and, for the reasons discussed above, is not rendered obvious by the teachings of Raidel and Obeshaw. In addition, this claim recites that the body has a nonuniform distribution of fibers in the composite material.

A *prima facie* case of obviousness has not been made out for claim 7, since neither of the Raidel and Obeshaw references describes or suggests this feature. For this additional reason, the Board is respectfully requested to direct withdraw of the rejection of claim 7.

Claim 9

This claim is dependent from claim 1 and, for the reasons discussed above, is not rendered obvious by the teachings of Raidel and Obeshaw. In addition, this claim recites that flanges of the I-shaped cross-section have a greater density of fiber than a web of the cross-section extending between the flanges.

A *prima facie* case of obviousness has not been made out for claim 9, since neither of the Raidel and Obeshaw references describes or suggests this feature. For this additional reason, the Board is respectfully requested to direct withdraw of the rejection of claim 9.

Claims 29 and 49

Independent claim 29 recites a suspension system which includes a beam having an axle end connection at one end and a frame end connection at an opposite end, with a body of the beam being made of a composite material and having a cross-section with at least two flanges and a generally vertical web extending between the flanges. This claim is not rendered obvious in light of the teachings of the Raidel and Obeshaw references.

As discussed above, Raidel describes a U- or box-shaped suspension arm. Raidel also does not describe how a metal end connection could be incorporated into a composite beam body. These deficiencies in the Raidel reference are not cured at all by combining it with the Obeshaw reference. Obeshaw merely describes a crushable composite structure (unsuitable, it appears, for constructing a suspension arm).

As stated in MPEP §2142, for a *prima facie* case of obviousness to be established, "... the reference (or references when combined) must teach or suggest all the claim limitations." In the present case, all the claim limitations have clearly not been taught or suggested by the combination of the Raidel and Obeshaw references. For at least this reason, the Board is respectfully requested to direct the examiner to withdraw the claim rejections.

Even if a *prima facie* case of obviousness had been made out, the rejections do not satisfy the requirements set forth in the seminal U.S. Supreme Court case of *Graham v. John Deere* for evaluating whether an invention would have been obvious to a person of ordinary skill in the art at the time the invention was made. These requirements include determining the level of skill of the person having ordinary skill in the art, the scope and content of the prior art, and the differences between the claimed invention and the prior art. Additional considerations may include factors such as failure of others to solve the relevant problem, long felt but unsatisfied need, skepticism of others, teaching away in the prior art, unexpected results, copying, the pace of innovation in the art, commercial success, industry accolades, etc.

In the *Graham v. John Deere* opinion, the Supreme Court also explicitly warned against "slipping into use of hindsight" in obviousness determinations. *Graham v. John Deere Co.*, 383 U.S. 1, 36 (1966). Additionally, in the more recent case of *KSR v. Teleflex*, the Supreme Court has reiterated that an invention's merit is not to be evaluated from a perspective of a person having the benefit of already knowing the solution conceived by the inventor, but rather as it would have been perceived by a person having only ordinary skill in the pertinent art. *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1742-43 (2007).

In the present case, the person having ordinary skill in the art would likely have a bachelor's degree in engineering or a related applied science field, and would likely have several years' experience in designing suspension system components. Such a person would be aware of conventional trailing arm suspension systems.

The scope and content of the prior art have been discussed above. However, it should be reiterated here that Raidel does not describe how the problems of making a suspension system arm out of composite materials could be solved, and Obeshaw does not describe any composite structure which is configured for use as a suspension system arm.

The differences between the prior art and the claimed invention are that none of the references describes a suspension system arm or beam made of a composite material, with an axle end connection at one of its ends and a frame end connection at

an opposite end, and with a body of the beam having a generally vertical web extending between two flanges. Some of these features are described in the cited references, but in no way describing or suggesting how the problems of making a composite suspension system arm could be solved.

The Board of Patent Appeals and Interferences recently addressed this issue in *Ex Parte Whalen II* (Appeal 2007-4423, July 23, 2008) as follows:

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> The Court held that the TSM test must be applied flexibly, and take into account a number of factors "in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed." *Id.* at 1740-41. Despite this flexibility, however, the Court stated that "it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the [prior art] elements in the way the claimed new invention does." *Id.* "To facilitate review, this analysis should be made explicit." *Id.*
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> [W]hen the prior art teaches away from the claimed solution as presented here . . . obviousness cannot be proven merely by showing that a known composition could have been modified by routine experimentation or solely on the expectation of success; it must be shown that those of ordinary skill in the art would have had some apparent reason to modify the known composition in a way that would result in the claimed composition.

In the present case, no convincing reasoning has been presented as to why a person skilled in the art would have been motivated to make the invention recited in the claims. The Raidel reference merely describes a conventional trailing arm suspension system. The Obeshaw reference merely describes a crushable composite structure. There is no reason why a person skilled in the art would use the Obeshaw crushable composite structure in the Raidel suspension system.

For this additional reason, the Board is respectfully requested to direct withdrawal of the rejections of claim 29 and its dependents.

Claim 30

This claim is dependent from claim 29 and, for the same reasons discussed above, is not rendered obvious by the proposed combination of the Raidel and Obeshaw references. In addition, this claim recites that the flanges of the beam body wrap outwardly about the axle end connection.

A *prima facie* case of obviousness has not been made out, since neither of the Raidel and Obeshaw references describes this feature of the invention. For this additional reason, the Board is respectfully requested to direct withdrawal of the rejection of claim 30.

Claim 37

This claim is dependent from claim 29 and, for the same reasons discussed above, is not rendered obvious by the proposed combination of the Raidel and Obeshaw references. In addition, this claim recites that the flanges of the beam body are attached directly to the axle.

A *prima facie* case of obviousness has not been made out, since neither of the Raidel and Obeshaw references describes this feature of the invention. For this additional reason, the Board is respectfully requested to direct withdrawal of the rejection of claim 37.

Claim 38

This claim is dependent from claim 37 and, for the same reasons discussed above, is not rendered obvious by the proposed combination of the Raidel and Obeshaw references. In addition, this claim recites that the web of the beam body is attached directly to the axle.

A *prima facie* case of obviousness has not been made out, since neither of the Raidel and Obeshaw references describes this feature of the invention. For this

additional reason, the Board is respectfully requested to direct withdrawal of the rejection of claim 38.

Claim 39

This claim is dependent from claim 37 and, for the same reasons discussed above, is not rendered obvious by the proposed combination of the Raidel and Obeshaw references. In addition, this claim recites that the flanges of the beam body extend at least partially about the axle.

A *prima facie* case of obviousness has not been made out, since neither of the Raidel and Obeshaw references describes this feature of the invention. For this additional reason, the Board is respectfully requested to direct withdrawal of the rejection of claim 39.

Claim 40

This claim is dependent from claim 37 and, for the same reasons discussed above, is not rendered obvious by the proposed combination of the Raidel and Obeshaw references. In addition, this claim recites that the axle is made from a composite material.

A *prima facie* case of obviousness has not been made out, since neither of the Raidel and Obeshaw references describes this feature of the invention. For this additional reason, the Board is respectfully requested to direct withdrawal of the rejection of claim 40.

Claim 41

This claim is dependent from claim 29 and, for the same reasons discussed above, is not rendered obvious by the proposed combination of the Raidel and Obeshaw references. In addition, this claim recites that the flanges of the beam body wrap outwardly about the frame end connection.

A *prima facie* case of obviousness has not been made out, since neither of the Raidel and Obeshaw references describes this feature of the invention. For this additional reason, the Board is respectfully requested to direct withdrawal of the rejection of claim 41.

Claim 44

This claim is dependent from claim 29 and, for the same reasons discussed above, is not rendered obvious by the proposed combination of the Raidel and Obeshaw references. In addition, this claim recites that the flanges of the beam body have a greater density of fiber than the web.

A *prima facie* case of obviousness has not been made out, since neither of the Raidel and Obeshaw references describes this feature of the invention. For this additional reason, the Board is respectfully requested to direct withdrawal of the rejection of claim 44.

In the Office Action, it is suggested that Raidel shows a portion of the beam body having a thicker cross-section and, thus, inherently having a greater density. As will be readily appreciated, density is equal to units (mass, number, etc.) divided by volume. A larger cross-section (greater area) does not equate to greater density. Instead, a larger cross-section can have the same density (units/volume) as any other cross-section. A larger cross-section does not inherently have a greater density.

For this additional reason, the Board is respectfully requested to direct withdrawal of the rejection of claim 44.

Claim 46

This claim is dependent from claim 29 and, for the same reasons discussed above, is not rendered obvious by the proposed combination of the Raidel and Obeshaw references. In addition, this claim recites that the body cross-section is generally I-shaped.

A *prima facie* case of obviousness has not been made out, since neither of the Raidel and Obeshaw references describes this feature of the invention. For this additional reason, the Board is respectfully requested to direct withdrawal of the rejection of claim 46.

Claim 52

This claim is dependent from claim 29 and, for the same reasons discussed above, is not rendered obvious by the proposed combination of the Raidel and Obeshaw references. In addition, this claim recites that the body has a nonuniform distribution of fiber therein.

A *prima facie* case of obviousness has not been made out, since neither of the Raidel and Obeshaw references describes this feature of the invention. For this additional reason, the Board is respectfully requested to direct withdrawal of the rejection of claim 52.

Claim 53

This claim is dependent from claim 29 and, for the same reasons discussed above, is not rendered obvious by the proposed combination of the Raidel and Obeshaw references. In addition, this claim recites that the axle is made of a composite material.

A *prima facie* case of obviousness has not been made out, since neither of the Raidel and Obeshaw references describes this feature of the invention. For this additional reason, the Board is respectfully requested to direct withdrawal of the rejection of claim 53.

Respectfully submitted,
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I hereby certify that this correspondence is being filed in the U.S. Patent and Trademark Office electronically via EFS-Web, on January 14, 2009.

/Sally Ann Smith/
_____
Sally Ann Smith

CLAIMS APPENDIX

1. A suspension system for a vehicle having a frame, the suspension system comprising:

an axle; and

a beam interconnected between the vehicle frame and the axle, the beam having opposite ends, an elongated body extending between the opposite ends, and a metal end connection at one of the opposite ends, the body being made of a composite material, and the body having a generally I-shaped cross-section.

2. The suspension system according to claim 1, wherein the end connection is a frame pivot connection.

3. The suspension system according to claim 1, wherein the end connection is an axle connection.

4. The suspension system according to claim 3, wherein the axle is made of an axle composite material.

5. The suspension system according to claim 1, wherein the end connection has a cavity formed therein, the body being received in the cavity.

6. The suspension system according to claim 1, wherein the end connection is received internally in the body.

7. The suspension system according to claim 1, wherein the body has a nonuniform distribution of fibers in the composite material.

8. (canceled)

9. The suspension system according to claim 1, wherein flanges of the I-shaped cross-section have a greater density of fiber than a web of the cross-section extending between the flanges.

10-11. (canceled)

12. The suspension system according to claim 1, wherein the body has a generally tubular cross-section.

13. The suspension system according to claim 12, wherein upper and lower wall portions of the tubular cross-section have a greater density of fiber than central wall portions of the cross-section.

14. The suspension system according to claim 1, wherein the end connection includes a sleeve attached to a body coupling structure.

15. The suspension system according to claim 14, wherein the structure receives the body internally therein.

16. The suspension system according to claim 14, wherein the body receives the structure internally therein.

17. The suspension system according to claim 14, wherein the sleeve and body coupling structure are integrally formed.

18. The suspension system according to claim 14, wherein the sleeve encircles a pivot bushing.

19. The suspension system according to claim 18, wherein the pivot bushing pivotably connects the end connection to the vehicle frame.

20. The suspension system according to claim 18, wherein the pivot bushing pivotably connects the end connection to the axle.

21. The suspension system according to claim 14, wherein the sleeve extends at least partially about the axle.

22. The suspension system according to claim 1, wherein the end connection includes an axle coupling structure attached to the axle, and a body coupling structure attached to the body.

23. The suspension system according to claim 22, wherein the body coupling structure receives the body internally therein.

24. The suspension system according to claim 22, wherein the body receives the body coupling structure internally therein.

25. The suspension system according to claim 22, wherein the axle coupling structure and the body coupling structure are integrally formed.

26. The suspension system according to claim 22, wherein the axle coupling structure extends at least partially about the axle.

27. The suspension system according to claim 22, wherein the axle coupling structure is pivotably attached to the axle.

28. The suspension system according to claim 22, wherein the axle is made of a composite material.

29. A suspension system for a vehicle having a frame, the suspension system comprising:

an axle; and

a beam interconnected between the vehicle frame and the axle, the beam having opposite ends, an elongated body extending between the opposite ends, an axle end connection at one of the opposite ends, and a frame end connection at the other of the opposite ends, the body being made of a composite material and having a cross-section with at least two flanges and a generally vertical web extending between the flanges.

30. The suspension system according to claim 29, wherein the flanges wrap outwardly about the axle end connection.

31. The suspension system according to claim 29, wherein the flanges are attached to an axle coupling structure of the axle end connection.

32. The suspension system according to claim 31, wherein the structure is rigidly attached to the axle.

33. The suspension system according to claim 31, wherein the structure is pivotably attached to the axle.

34. The suspension system according to claim 31, wherein the structure extends at least partially about the axle.

35. The suspension system according to claim 31, wherein the structure is welded to the axle.

36. The suspension system according to claim 31, wherein the axle is made of an axle composite material.

37. The suspension system according to claim 29, wherein the flanges are attached directly to the axle.

38. The suspension system according to claim 37, wherein the web is attached directly to the axle.

39. The suspension system according to claim 37, wherein the flanges extend at least partially about the axle.

40. The suspension system according to claim 37, wherein the axle is made of an axle composite material.

41. The suspension system according to claim 29, wherein the flanges wrap outwardly about the frame end connection.

42. The suspension system according to claim 41, wherein the flanges are attached to a frame coupling structure of the frame end connection.

43. The suspension system according to claim 42, wherein the frame coupling structure extends about a pivot bushing.

44. The suspension system according to claim 29, wherein the flanges have a greater density of fiber than the web.

45. The suspension system according to claim 29, wherein upper and lower end portions of the flanges have a greater density of fiber than the web.

46. The suspension system according to claim 29, wherein the body cross-section is generally I-shaped.

47. (canceled)

48. The suspension system according to claim 29, wherein the frame end connection includes a structure which straddles a hanger bracket attached to the vehicle frame.

49. The suspension system according to claim 29, wherein at least one of the axle and frame end connections is made of metal.

50. The suspension system according to claim 29, wherein each of the axle and frame end connections is made of metal.

51. The suspension system according to claim 29, wherein at least one of the axle and frame end connections has a cavity formed therein, the body being received in the cavity.

52. The suspension system according to claim 29, wherein the body has a nonuniform distribution of fiber therein.

53. The suspension system according to claim 29, wherein the axle is made of a composite material.

EVIDENCE APPENDIX

(none)

RELATED PROCEEDINGS APPENDIX

(none)